# Functional Requirement

2. Functional Requirements (Total 23 Items)  
2.1 Data Collection  
Input: Real-time data from probe vehicles, traffic sensors, weather stations, and traveler information systems.  
Output: Raw data stored in Oracle 10G database.  
Description: The system must receive, validate, and store incoming data from various external sources.  
2.2 Data Quality Check  
Input: Raw data records.  
Output: Validated or rejected data entries.  
Description: The system must perform automated checks on data integrity, format, and plausibility.  
2.3 Traffic Metrics Calculation  
Input: Validated traffic data.  
Output: Congestion levels, travel times, queue lengths.  
Description: The system must calculate key traffic performance indicators using predefined algorithms.  
2.4 Incident Detection and Classification  
Input: Anomalies in traffic flow or sensor data.  
Output: Incident reports with type, location, severity, and time.  
Description: The system must detect potential incidents and classify them based on predefined rules.  
2.5 Road Surface and Weather Condition Inference  
Input: Weather station data and environmental sensor readings.  
Output: Road surface state (e.g., icy, dry), temperature, precipitation.  
Description: The system must infer current road and weather conditions using environmental data.  
2.6 Dynamic Data Caching  
Input: Processed data.  
Output: Cached data accessible within minutes.  
Description: The system must maintain a dynamic cache of recent data for quick access by internal and external applications.  
2.7 Long-Term Archiving  
Input: Historical data.  
Output: Archived data stored for future analysis.  
Description: The system must archive all processed data in Oracle 10G for retrieval and historical analysis.  
2.8 Data Publication  
Input: Processed data.  
Output: Published data in TMDD and SAE J2354 formats.  
Description: The system must generate standardized output files and publish them to designated endpoints.  
2.9 Alert Generation  
Input: Incident or weather event data.  
Output: Alerts sent via email, SMS, or API.  
Description: The system must generate and deliver alerts based on thresholds and user-defined rules.  
2.10 MI Drive Presentation Support  
Input: Processed data.  
Output: Data formatted for MI Drive visualization tools.  
Description: The system must provide compatible outputs for use with MDOT's MI Drive system.  
2.11 Web-Based User Interface  
Input: User queries and selections.  
Output: Map display, incident icons, and data overlays.  
Description: The system must provide a web-based UI with map-based views, icon layers, and de-cluttering capabilities.  
2.12 Extensibility and Configuration  
Input: New data source definitions or algorithm configurations.  
Output: Updated processing pipelines or outputs.  
Description: The system must allow for configuration of new data sources, algorithms, and output formats without code changes.  
2.13 User Access Control  
Input: User identity and role definition.  
Output: Controlled access permissions.  
Description: The system must implement Role-Based Access Control (RBAC) to ensure users only access authorized data and functions.  
2.14 Historical Data Query  
Input: Time range, location, and data type.  
Output: Historical data records matching criteria.  
Description: The system must allow users to query past traffic, weather, and event data with visualization or export options.  
2.15 Automated Report Generation  
Input: Report template, time range, geographic area.  
Output: PDF or HTML report containing key metrics.  
Description: The system must support generating daily, weekly, or monthly reports with statistics like average speed, congestion index, and incident counts.  
2.16 Multi-Language Support  
Input: Selected language (default: English).  
Output: Localized interface and message display.  
Description: The system must support multiple languages (e.g., English, Spanish) to serve diverse user groups.  
2.17 Mobile-Friendly Interface  
Input: Mobile device access request.  
Output: Responsive web interface optimized for mobile devices.  
Description: The system must be designed to work seamlessly on smartphones and tablets, including map browsing and alert notifications.  
2.18 Third-Party API Integration  
Input: External service APIs (e.g., Google Maps, Waze, Twitter).  
Output: Integrated data stream or interactive features.  
Description: The system must support integration with third-party APIs to enhance data collection and public feedback mechanisms.  
2.19 Real-Time Dashboard  
Input: Selected monitoring object (e.g., a highway, city).  
Output: Dynamically updated charts and metrics.  
Description: The system must provide a customizable real-time dashboard showing traffic flow, weather trends, and event frequencies.  
2.20 Data Sharing and Collaboration  
Input: Shared links or reports created by users.  
Output: Accessible shared content (with permission control).  
Description: The system must allow users to share specific map views, reports, or alerts with others internally or externally.  
2.21 Disaster Recovery Mechanism  
Input: System failure or disruption signal.  
Output: Automatic failover to backup node and service restoration.  
Description: The system must have high availability and disaster recovery capabilities to ensure continuous operation during outages.  
2.22 Custom Algorithm Module  
Input: User-submitted scripts or rule files.  
Output: Results from custom processing logic.  
Description: The system must support user-uploaded algorithms for specialized traffic data analysis, such as predicting peak traffic patterns.  
2.23 Event Lifecycle Management  
Input: Event creation, modification, or closure requests.  
Output: Updated event status and audit logs.  
Description: The system must track the full lifecycle of each event (detection to resolution), including assignments, progress, and completion logs.

# External Description

3. External Interfaces  
3.1 Hardware Interfaces  
Oracle 10G Database Server  
Java Application Server  
Geospatial Servers (for map rendering)  
Data Acquisition Devices (e.g., traffic sensors, weather stations)  
3.2 Software Interfaces  
JDBC for Oracle 10G connectivity  
Standard SQL for querying and reporting  
Web Services (REST/JSON) for data exchange  
GIS APIs for map rendering and georeferencing  
MI Drive API for integration with MDOT visualization tools  
3.3 Communication Interfaces  
TCP/IP for network communication  
HTTPS for secure data transmission  
MQTT for real-time data streaming from probe vehicles  
3.4 User Interfaces  
Web-based dashboard with interactive maps  
Icon overlay and layer control options  
Search and filtering capabilities  
Alert subscription and notification settings